Comparative Study of Untreated and Treated Waste Water belonging to Sewage Treatment Plants of Ajmer with special reference to Planktonic Dynamics

(प्लवकों की गतिशीलता के विशेष संदर्भ में अजमेर के मलजल संयत्रों द्वारा उपचारित और अनुपचारित अपशिष्ट जल का तुलनात्मक अध्ययन)

A REVISED

SYNOPSIS SUBMITTED FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN

SCIENCE

DEPARTMENT OF ZOOLOGY

To

MAHARSHI DAYANAND SARASWATI UNIVERSITY

AJMER

2017

Submitted By
Khushaboo Soni
Department of Zoology
S.P.C. Govt. College, Ajmer

Under the supervision of
Dr. Reena Vyas
Department of Zoology
S.P.C. Govt. College, Ajmer

MAHARSHI DAYANAND SARASWATI UNIVERSITY, AJMER

APPENDIX- IV

FORMAT FOR OUTLINE OF PROPOSED RESEARCH WORK

1. **Name of Scholar (In English)** : Khushaboo Soni

   (In Hindi) : खुशबू सोनी

2. **Title of Research Work**

   (In English) **:** Comparative Study of Untreated and Treated Waste Water belonging to Sewage Treatment Plants of Ajmer with special reference to Planktonic Dynamics

   (In Hindi) **:** प्लवकों की गतिशीलता के विशेष संदर्भ में अजमेर के मलजल संयत्रों द्वारा उपचारित और अनुपचारित अपशिष्ट जल का तुलनात्मक अध्ययन

3. Location **:**

   (a) Institute/Department where the work is to be done.

   (b) Geographical area of investigation: Ajmer, Rajasthan

4. Importance of proposed Investigation.
5. Review of work already done on the subject of proposed research study.
6. Research gaps identified in the proposed field of investigation.
7. Objectives.
8. Major Hypothesis.
9. Materials and methods/Research methodology
10. Chapter wise details of proposed research
11. Bibliography

Outline Approved

Signature of Candidate with date

Name and signature of supervisor
With date and seal

1. Name of Scholar (In English) : Khushaboo Soni

(In Hindi) : [kq'kcw lksuh

2. Title of Research Work:

(In English) **:** Comparative Study of Untreated and Treated Waste Water belonging to Sewage Treatment Plants of Ajmer with special reference to Planktonic Dynamics

(In Hindi) **:** प्लवकों की गतिशीलता के विशेष संदर्भ में अजमेर के मलजल संयत्रों द्वारा उपचारित और अनुपचारित अपशिष्ट जल का तुलनात्मक अध्ययन

3. Location

(a) Department of Zoology S.P.C. Govt. College, Ajmer

(b) Geographical area of investigation: Ajmer, Rajasthan

- Rajasthan is largest province of India situated at western side of the country and Ajmer district is situated nearly in the centre of Rajasthan, Ajmer city is located at latitude 26.475^{o} N and longitude 74.625^{o} E. It was founded by Ajaipal Chouhan in 7^{th} century. Anasagar Lake is in the central part of Ajmer and was made by Arnoraj Chouhan the grandfather of Prithviraj Chouhan in 1135-1150 A.D. (12^{th} century).
- The Khanpura tank is situated at the southern end of the Ajmer city. The area of Khanpura is not rocky but in this area hard soil/soil mixed with black cotton soil is found. In the rainy season when the Anasagar Lake overflows then the drainage falls into the Khanpura tank.

4. IMPORTANCE OF PROPOSED INVESTIGATION.

Water is one of the most vital, abundant, versatile, and precious natural resource. It is endowed by Mother Nature as the life's fundamental resource for human and important for an ecosystem. On our earth, more than 97% of water is stored in oceans and only 3% is fresh water and in this 3% less than 1% of water is available for consumption (human activities).

In historic times, sewage disposal method used by human was improper. Disposal of sewage in natural water bodies leads to unhealthy living conditions. In the ancient times Roman developed flushed community latrines. In this the first documented large scale reuse

of grey water was users sat on benches suspended over trenches as waste was flushed away by user public bath water.

Around A. D. 100 Romans completed most of the sewer system's infra structure by direct connections from houses to sewers began. Sewers were laid throughout the city, serving public and some private latrine.

In 1800 in U.S. and Europe chamber pots were back in vogue they forgotten the advances which was made by Romans. Disposal of chamber pots in the street gutters was preferred in large cities like New York, Paris or London. In European cities there was a thriving cottage industry would empty the barrels in river bank or near open source of water. Due to discharge of sewage in these areas, typhoid and cholera diseases spread by improper waste disposal. In 1811, people became aware of ill-effect of improper sanitation when King Edward VII suffered from water disease typhoid.

In 19^{th} century when Louis Pasteur and other scientists showed that sewage born bacteria were responsible for many infectious diseases then people of large cities realized that they must reduce the water pollution which was released into the environment by them. In 20^{th} century method of waste water treatment totally changed due to change in waste water characteristics.

India is one of the fastest developing countries and due to the urbanization, population explosion, civilization, industrialization; water demand is increasing day by day. So we need to reuse water to tackle the problem of industrial pollution and waste water. CPCB (Central Pollution Control Board) launched the water pollution control agenda in 1992. That is why, in the urban areas or cities, the sewage is collected in a programmed manner, known as Sewage Treatment Plant (STP). According to CPCB (2005, a) in India 234-STP's are present out of those mostly are developed under various river action plants (from 1978-79 onwards). In all this only 5% of STP's are located in cities/town along the banks of major rivers. In the STP the waste water/sewage water is treated. In the process of sewage treatment, organic, inorganic, sand, plastic waste, oil, grease, metals & many more things or contaminants are removed from influent.

Discharged water mainly produced by domestic residence, commercial properties, industry, agriculture, hospital and institutions is called waste water. It mainly contains organic or inorganic elements, toxic compounds, numerous pathogens, microorganisms or dangerous pollutants such as nitrates, carbon etc.

But the term sewage is different from waste water. Sewage is a mixture of domestic wastes (It includes human faeces or urine) and industrial waste. This mixture is called sanitary sewage or simply sewage.

The process of removing of chemical, biological & physical contaminants with the help of chemical, biological & physical processes from the runoff (effluents) domestic, industrial waste is to get the treated water. In India such treated water is useful for the agricultural purpose only.

If untreated water/sewage is mixed in the lake water then the large amount of organic matter present in the sewage water decrease the dissolved oxygen of the lake and leads to death of aquatic biota like fishes and other undesirable effects will be shown. The untreated sewage water which runoff directly in lake can be harmful for environment and public health because it contains toxic compound, numerous pathogens or disease causing microorganisms.

The term plankton comes from greek word **planktos** which means wandering. Plankton are heterogeneous group of microscopic plants (phytoplankton) and animals (zooplankton). They are free floating in water. Diversity of plankton or aquatic organism is influenced by the seasonal variation of physico-chemical properties of water. Plankton are good indicators of quality of water, the status of water bodies and environmental pollution.

As per CPCB present status of STP's in Rajasthan, there are 63 STP's with 865.92 MLD capacities. Out of these 63 STP's; 36 STP's with 322.12 MLD capacities are proposed and 11 STP's with 149.3 capacities are under construction.

ADA of Ajmer on the behalf of Governor, Government of Rajasthan invited a notice for bids for work under RUIDP (Rajasthan Urban Infrastructure Development Project) for integrated development of towns. Under the JnNURM (Jawaharlal Nehru National Urban Renewal Mission) scheme, Ministry of urban development has proposed two STP's in Ajmer.

Anasagar Lake is one of the conservational lake of India as well as Rajasthan. Government of India has included the lake Anasagar in National lake conservation plan (NLCP) initiated in June 2001. Anasagar Lake was covered under NLCP in Nov. 2007 so there is one STP at Anasagar Ajmer whose capacities are 13 MLD.

Khanpura tank is situated at the southern end of the Ajmer city. The area of Khanpura is not rocky but in this area hard soil/soil mixed with black cotton soil is found. In the rainy season when the lake Anasagar overflows then the drainage falls into the Khanpura tank so

second STP is situated at Khanpura whose capacities are 60 MLD (20 MLD + 40 MLD under construction). Both STP's are based on activated sludge process/SBR (sequential batch reactor). STP of Khanpura is power generation plant which is generating power from gases produced from sludge digestion.

No specific investigation has been conducted on STP Anasagar & STP of Khanpura. Any report, paper is not available on physico-chemical properties of sewage water. Planktonic population is also not available with the seasonal change in both STP.

In the plant we can assess the water quality either by monitoring the physico-chemical properties of influent and effluent sewage water or by inhabiting analysis of biota. Planktons are mainly comprised as a biota.

So this study shall be to compare the physico-chemical characteristics of water, among Khanpura & Anasagar Lake STP's and to find out the composition & density of planktons with special reference to monthly variations in both STP's.

5. REVIEW OF LITERATURE

Water is one of the vital components of life and its quality and properties influenced the biota directly or indirectly by various means. Several studies were already carried out even from the ancient time. Proper scientific documentation was started by **Aristotle (384-322 B.C.)** in the form of fresh water life forms.

In the previous year some scientists had studied physico chemical properties and plankton distribution in various water bodies around the country.

In 18^{th} century various authors studied some water based organisms, their habitats and behaviours in water **(Muller *et al.*).** The decision forward step from hydrobiology to limnology was taken by **Forel (1841-81)** who is considered as **Father of Limnology**.

Muthukumaran and Ambujam (2003) worked on waste water treatment and management in urban areas of Panjappur and Srirangam, during this study they took samples and the results were compared with FAO irrigation water quality standards.

Chindah *et al.* (2007) stated that the variation of phytoplankton communities and their interaction with the physico-chemical characteristics of the waste water being treated with sunlight is having significant correlation. Their results suggest that phyto-plankton were mainly regulated by nutrients and the massive cyano-bacterial bloom declined as the water quality improved which were well related to changes in algae diversity.

Charan *et al.* (2008) studied on pesticide contamination in Lake Anasagar & they stated that the water of Anasagar is highly contaminated with organo-chlorine such as Hepta Chlor, Beta HCH, ppDDD, ppDDE, ppDDT and Aldrin.

Katona (2008) presented the significance of the bio-indicators concerning environmental protection within the process of cleaning sewage.

Pradhan, Mukherjee, and Khanam (2008) studied on the object of unravel the reason for the markedly greater efficiency of the Bheris in fish compared to other water bodies. Architecture of the Bheris itself proposed that plankton can act as biomarker for water quality assessment in fish production.

Sharma *et al.* (2008) studied on physico-chemical parameters of Anasagar Lake. Their result shows that hyper eutrophic condition and sedimentation also reduces the water bearing capacity of the lake.

Mitharwal *et al.* (2009) analyzed physico-chemical parameter of the ground water sample in Pilani. They observed that nitrate values are higher as compared to ICMR standards and nitrate alone is making ground water unfit for drinking. Other parameters were found within desirable limits.

Sharma *et al.* (2010) anlysed the water quality status of Gundolav lake. They showed significant relation between physico-chemical parameters and zooplankton composition.

Sukhija (2010) studied on Foy Sagar Lake and stated that the lake water is alkaline, moderately hard and nutrient rich with low value of dissolved oxygen.

Dhall *et al.* (2011) studied the performance of isolated designed consortia comprising *Bacillus pumilus*, *Brevibacterium sp.* and *Pseudomonas aeruginosa* for the treatment of sewage waste water in terms of reduction in COD, BOD, MLSS and TSS.

Khushwah *et al.* (2011) studied on influent and effluent water quality at municipal waste water treatment plant, Bhopal.

Koli and Ranga (2011) studied on anasagar lake and stated that primary productivity and physico-chemical values of the lake were found high, mainly due to sewage discharged, industrial effluents and agricultural runoff by surrounding city population.

Sharma *et al.* (2011) studied physico-chemical parameter of Pushkar Lake. In this most of the parameters were found to be slightly higher than the IS permissible limit. They concluded that in its present form, tourism in the study area does not meet the criteria for true sustainable development.

Turkar *et al.* (2011) studied on waste water with various methods such as activated carbon adsorption, chemical oxidation, biological treatment.

Gutkowska (2012) studied the effectiveness of quantitative and qualitative zooplankton sampling with the use of the Ruttner sampler and the apstein plankton net was compared during a study conducted in the vistula lagoon.

Narmadha *et al.* (2012) analyzed the physico-chemical and biological parameters of septic water before and after treatment with horse and cow dung; and potable water. They isolated and identified the microbes present in horse and cow dung by using biochemical tests.

Sanamdikar and Harne (2012) studied on sewage water treatment by various methods such as physical, chemical and biological unit processes. They used programmable logic controller (PLC) to develop an automated continuous process system for treating the waste water.

Agyemang *et al.* (2013) analyzed sixteen water quality parameters in influent and effluent waste water samples of the treatment plant for a year and their average values were compared with EPA(Ghana) guidelines for beverage industries discharging into water bodies.

Mahapatra *et al.* (2013) studied on the treatment efficiency of algae-based sewage treatment plant (STP) of 67.65 million liters per day (MLD) capacity considering the characteristics of domestic waste water (sewage) and functioning of the treatment plant, while attempting to understand the role of algae in the treatment.

Awad *et al.* (2014) studied on Environmental Assessment of waste water treatment plants (WWIPs) for old rustamiya project. Their results concluded that the removal of BOD is highest during study and about 88.71% and 87.47% COD removal can be achieved in stage 0 and stage 1.

Farashi *et al.* (2014) studied the spatial and seasonal distribution of plankton in the native habitat of the Iranian cave barb and they measured various environmental parameters and related these to plankton distribution with the help of pearson correlation coefficients and they showed a low but significant relationship.

Gupta and Meena (2014) analyzed physico-chemical characteristics of drinking water supplied by PHED in bharatpur district of Rajasthan and some water samples compared to BIS standards.

Mustapha (May, 2014) analyzed the physical and chemical parameters in some rivers in Yobe state.

Wakode and Sayyad (2014) evaluated the performance of 25 MLD STP at Kalyan which is based on sequential Batch Reactor (SBR) process. They concluded from this study

that there is need for continuous monitoring and performance analysis by removal efficiencies of each and every unit of STP.

Angelakis and snyder (2015) studied the special issue on waste water treatment and Reuse: Past, Present, Future. They include advanced waste water treatment and technologies, such as membrane bioreactor electrochemical system; denitrifying biofilters, and disinfection technologies.

Hangargekar and Takpere (Nov. 2015) studied on waste water treatment plant, common effluent treatment plant for textile industry. The waste water is analyzed for water quality parameters.

Khanna and Rai (2015) studied ground water quality of Peesangan Block and they observed that water sample have concentration of different parameters beyond the permissible limits and it was not suitable for drinking and other domestic purpose.

Singh (2015) analyzed the physico-chemical parameters of open pond in town Deeg and plankton diversity and density. Planktons were counted by using Sedgwick 4 Rafter Counting cell method. Five family of phyto plankton and three group of zooplankton were studied there.

Verma and Khan (2015) analyzed water quality by physico-chemical parameters in Fateh Sagar lake in Bagar, Rajasthan.

Asiwal *et al.* (2016) studied on waste water treatment by effluent treatment plants in steel industries, benefit of this research work will be recycling, reuse of water and sludge from steel industry.

Patil *et al.* (2016) designed a sewage treatment plant for dhule city.

Badejo *et al.* (2017) studied physico-chemical parameters using standard water analysis methods of Yobe River(Gashua), Yobe state. They observed that some parameters were within the recommended range for tolerable limits for fish production.

Choudhury *et al.* (2017) evaluated physico-chemical parameter and revealed a significant variation in water chemistry parameters. Detailed aspect of diversity and seasonal variation of zooplankton were discussed.

Hemath Naveen *et al.* (March 2017) presented the various study about the sewage treatment and efficiency of cleaning process of various waste water.

Jamdade and Gawande (2017) analyzed the quality of water at some time interval with the help of different parameters and they concluded that the physico-chemical parameters varies with the sources of pollutants.

Sreelekshmi and Pereira (2017) evaluated physico-chemical parameters and plankton diversity from Vellayani Lake with special reference to the condition factor of *Devario* species.

Taruni and Kapila (2017) studied on phytoplankton population in relation to physico-chemical properties of Tapi River. Quantitative estimation of phytoplankton was done by using standard method. Pearson correlation was calculated among the various physico-chemical variables and phyto plankton density.

Vaishnav *et al.* (2017) estimated water quality physico-chemical parameters which indicated of pollution level and biological analysis performed by MFM. Their results show that water quality of Shivnath River is below the standard limits as it is unsuitable for domestic and drinking purpose.

6. RESEARCH GAPS IDENTIFIED IN THE PROPOSED FIELD OF INVESTIGATION.

After reviewing the available literature not a paper, journal has been published and none of the above research has been done on both STP's of Anasagar Lake & Khanpura tank.

7. OBJECTIVES:

For the fulfillment of these research gaps the present study will be undertaking with the following objective:

1. To find out seasonal variation in physico-chemical properties of influent and out fluent water at Anasagar & Khanpura sewage treatment plants.
2. To estimate the BOD & COD of sewage influent, and effluent water and their correlation with the help of statistical tools.
3. To observe variation in composition/diversity of planktonic population and their relationship with various physico-chemical parameters of water.

8. MAJOR HYPOTHESIS:

The aim of the present study is the conservation of Anasagar Lake and reuse of water of Khanpura STP with the help of comparative study of physico-chemical characteristics of the influent & effluent water. The physico-chemical parameters of water for both STP will be compared.

When physico-chemical parameters will change then diversity & response of plankton which are free floating & living in water also will be significantly change due to their short life. They will react quickly with the changes in parameter (environment, properties.). We can determine their abundance occurrence and influenced with seasonal variation because they are indicator or biological ecosystem & their species composition indicates the quality of water.

Null Hypothesis: According to null hypothesis there is no significant relation/difference between physico-chemical parameter of STP with seasonal variation and planktonic diversity. According to this if physico-chemical parameter of influent and efluent will change with season then diversity of plankton will not be changed.

Alternative: According to alternative hypothesis there is significant relation/difference between physico-chemical parameter of STP with seasonal variation and planktonic diversity. According to this if physico-chemical parameter of influent and effluent will change with season then diversity of plankton will be changed.

9. RESEARCH METHODOLOGY:

During the study, sample of influent and effluent water for both STP's will be collected at seasonal interval during 2018-19 or 2019-20. Sample will be collected in 2-5 liter plastic container. Before water sample collection, container will be pre cleaned by washing with non toxic or non ionic detergents. Then it will be rinsed with tap water & distilled water. After that it will be rinsed with sampling water then the container will be filled with sampling water up to the 3/4 mark leaving some space for aeration, mixing etc. Cover the sampling container/bottle with stopper/cork/cap. Then the container will be labeled for influent and effluent sample respectively.

For physico-chemical parameters of water the methods will be followed are:-

- Temperature of Inlet & Outlet water will be recorded on the same day/time after collecting the sample. Temperature will be recorded by using centigrade thermometer.
- The pH (negative logarithm of hydrogen ion concentration) of inlet & outlet water on the given temperature will be measured by grip pH meter (electrometric method).
- To estimate the Dissolved Oxygen, the Winkler method will be used with a zide modification/membrane electrode method/standard method as given in APHA 2005.
- To estimate the Dissolved solids, will be used digital TDS meter (Hold).
- For the estimation of BOD will be used Titrimetric method/Respirometric method or standard method as given in APHA 2005 or Trivedi & Goel.
- For the estimation of COD we will use open reflux method/closed reflux (titrimetric & colorimetric) method using COD digested or standard method given in APHA (2005) or Trivedi & Goel.

For qualitative analysis of plankton sample, sample will be collected with the help of towing Hansen's standard planktonic net which is made of no. 25 bolting silk. After sampling, sample will be fixed in 70% ethyl alcohol.

For quantitative analysis of plankton we will filter surface water from pre collecting sample with the help of 25 no. bolting silk net & 10 ml. sub sample will be chosen from both sample and plankton counting. Counting will be done in counting chamber under C.Z. inverted microscope.

- For plankton collection, plankton net will be used which is made of bolting nylon cloth.
- To identify the plankton I will be using identification keys and standard references mentioned in Tonapi, Ballishand A.P.H.A., Edmondson, ward and whipple, pennak.
- For the numerical estimation of plankton "Sedgwick Rafter Cell" will be used. Plankton will be observed under the light microscope with the help of procedure given in the standard methods in APHA (2005).

Expected duration of proposed Research work

The proposed research work will be completed in two years. The year wise details are as follow:

During I year:

- Collection of literature concerning research topic.
- Study of both STP (Anasagar & Khanpura).
- To obtain the data pertaining to the objective.

During II year:

- Analysis of the collected data.
- Preparation for presentation (graphs, tables, figures and photographs).
- Compilation of the work and preparation of the Work.

10. CHAPTER WISE DETAIL OF PROPOSED RESEARCH

The chapters of the thesis are proposed as follows:

1 **Introduction**: This chapter will be covered with the view points about the research problem and details about the importance of the proposed research work:

- Present status of STP's in India, Rajasthan and Ajmer.
- Importance of selected sewage treatment plants(Anasagar & Khanpura) of Ajmer for reuse of sewage/waste water and sustainable development of Ajmer city.
- Objectives of proposed investigation

2 **Review of literature**: This chapter includes the recent literature regarding the STP's depending on published literature and annual data of various sources, journals, articles, papers, bulletin and reports of leading knowledge on STP's and planktonic diversity change with seasonal variation in physico-chemical parameters.

3 **Material and Methods**: This chapter includes the different methods for analysis of physico-chemical properties of sewage water for selected STP's in Ajmer. Sampling process for sewage water and planktons and different methods to calculate the quantitative and qualitative diversity of plankton. The details about the various

statistical tools going to be used for the proposed research work such as mean, SD, Co-relation, regression etc.

4 **Result and Discussion**: This chapter will be including the result regarding the selected objectives. The major results were selectively tabulated as well graphical representation will be done. The results will be discussed in the light of recent reviews. The hypothesis will be discussed.

5 **Conclusion and Suggestions**: This chapter will be including the key points as conclusion. The concluding points are regarding the objectives and hypothesis.

6 **Summary**.

Bibliography: The reference will be mentioned on the cross check basis with the Literature.

REFERENCES

- Agyemang, E.O., Awuah, E., Darkwah, L., Arthur, R. and Osei, G. (2013) "Water quality assessment of a waste water treatment plant in a Ghanaian Beverage Industry", IJWREE, 5(5), 272-279, ISSN 2141-6613.
- Angelakis, A.N. and Synder, S.A.(Water 2015) "Waste water treatment and Reuse: Past, Present and Future", Vol.-7: 4887-4895, ISSN-2073-4441.
- APHA (2005), Standard Methods for the examination of water and waste water. 21st Edition, American Public Health Association, American Water Work Association (AWWA) and Water Environment Federation (WEF) Washington, D.C., NewYork.
- Asiwal, R.S., Sar, S.K., Singh, S. and Sahu, M.(2016) "Waste water Treatment by Effluent Treatment Plant", SSRG-IJCE, 3(12), 32-38, ISSN: 2348-8352.
- Awad, E.S., Al obaidy, A.H.M.J. and Almendilawi, H.R. (2014) "Environmental Assessment of waste water treatment plants (WWIPs) for old Rustamiya Project". Int.J.Sci.Eng.Tec.Res., Vol. 3(12) : 3455-3459, ISSN:2278-7798.
- Badejo, Ibrahim, B., Abdulrahman, A.K., Dali, Z.J. and Badgal, E.B. (2017) "Assessment of physico-chemical parameters of river Yobe, Gaushua, Yobe state, Nigeria", Int. J. of Fisheries and Aquatic studies, Vol. 5(2): 93-98, E-ISSN: 2347-5129, P-ISSN: 2394-0506.

- Charan, P.D., Patni, A. and Sharma, K.C.(2008) "Pesticide contamination in lake anasagar of Ajmer, Rajasthan", proceedings of Taal 2007: the 12th world lake conference: 360-365.
- Chindah, A.C., Braide, S.A., Amakiri, J. and Izundu, E.(2007) " Succession of phyto plankton in a municipal waste water treatment system under sunlight", revista UDO Agricola 7(1): 258-273.
- Choksi, K.N., Sheth, M.A. and Mehta, D.(2015) "To evaluate the performance of Sewage Treatment Plant: A Case Study, " IRJEET, e-ISSN: 2395-0056; p-ISSN: 2395-0072, Vol. 2(8): 1076-1080.
- Choudhary, A.N., Das, P., Das, V., Kar, S. and Kar, D.(2017) "Studies on Zooplankton abundance and physico-chemical parameters of Rukni Anua at Bekirpar in Cachar district, Assam", Int. J. Fisheries and Aquatic studies, Vol.-5(3): 372-374, E-ISSN: 2347-5129, P-ISSN: 2394-0506.
- City Development plan, price water house coopers, submitted to PDCOR limited, 2006, July, Govt. of India, Ajmer Municipal Council, Pushkar Municipal Board; Website Accessed: www.pdcor.com/Draft-city-development
- Conservation and Management of Lakes-An Indian perspective(2010), National River Conservation Directorate, Ministry of Environment and Forests (MOEF), Govt. of India, New Delhi-110003.
- CPCB. 2005. Status of Sewage Treatment in India Central Pollution Control Board, India.
- CPCB. Guide Manual: Water and Waste water Analysis.
- CPCB. 2005a. Parivesh Sewage Pollution-News letter. Central Pollution Control Board, Ministry of Environment and Forests, Govt. of India, Parivesh Bhawan, East Arjun Nagar, Delhi 110032. http://cpcbenvis.nic.in/newsletter/sewage pollution/contentsewagepoll-0205.htm
- CPCB.2015. Inventorization of sewage treatment plants, Control of Urban Pollution, Series CUPS/2015, Central Pollution Control Board, India.
- CPCB. 2015. Performance Evaluation of Sewage Treatment Plants in Central Zone, Central Pollution Control Board, Zonal Office-Bhopal, India.
- Dhall, P., Kumar, R. and Kumar, A.(2011) "Biodegradation of sewage waste water using autochthonous bacteria", the scientific world journal, Vol. 2012: pp-1-8, doi: 10.1100/2012/861903.

- Dhote, J., Ingole, S. and Chavhan, A.(2012) "Review on Waste Water Treatment Technologies," IJERT, Vol. 1(5), ISSN: 22748-0181.
- Farashi, A., Kaboli, M., Rezaei, H.R., Naghavi, M.R. and Rahimian, H.(2014) "Plankton composition and environmental parameters in the habitat of the Iranian cave barb(Iranvcypris typhlops) in Iran", Animal biodiversity and conservation, Vol. 37(1): PP I3-21, ISSN: 1578-665X, ISSN: 2014-928x.
- Garg, S.K.(Dec, 2016 Revised)"Sewage Disposal and Air Pollution Engineering: Environmental Engineering", Vol. II, ISBN No: 978-81-7409-230-4 Thirty Fifth Edition.
- Gupta, L.K. and Meena, R. R.(2014) "Physico-chemical analysis of drinking water supplied in Urban towns of Bharatpur district (Rajasthan)," Int. J. Chem. Sci.,Vol. 12(2): pp-593-599, ISSN-0972-768x.
- Gutkowska, A., Patwej, E. and kowalska, E.(2012) "Qualitative and quantitative methods for sampling zooplankton in shallow coastal estuaries", Ecohydrology & Hydrobioloty, Vol. 12(3): 253-263.
- Hangargekar, P.A. and Takpere K.P.(2015) "A case study on waste water treatment plant, CETP (Common Effluent Treatment Plant) Int. J. Inn. Res. Adv. Eng., Vol.-2(11) : pp-34-39, ISSN: 2349-2163.
- Hemath, N.K.S., Hema, P.M., Swathi, S.D. and Vinothan, K.G.(2017) "Sewage Treatment Methodology-A Review", IJETT, Vol.-45.pp-118-120, ISSN:2231-5381.
- Jamdade, A.B. and Gawande, S.M.(2017) "Analysis of water quality parameters: A review", Int. J. Eng. Res., Vol-6(3), pp:145-148, ISSN:2319-6890(online), 2347-5013(print).
- Katona, J.N.(2008) "The Environmental Significance of Bioindicators in Sewage Treatment", Acta Plytechnice Hungarica, Vol. 5(3): 117-124.
- Kaur, R., Wani, S.P., Singh, A. K. and Lal, K.(2012) "Waste Water Production, treatment and use in India".
- Khanna, P. and Rai, N.(2015) "Assessment of ground water quality of peesangan block of Ajmer district", Int. J. Cur. Res. Rev., Vol-8(4), pp: 39-46.
- Khanna, V. and Yadav, I.(2009)"Planktonic Diversity in the Holy Lake of Pushkar, Ajmer", Nature Environment and Pollution Technology, 8(2): 339-342.
- Koli, V. K. and Ranga, M.M.(2011) "Physico-Chemical status and Primary productivity of anasagar lake, Ajmer, Rajasthan, India," Univ. J. Envir. Res. Tech., Vol-1 (3): pp-286-292, e ISSN:2249-0256.

- Kordrostami, S.(2015) "Sewage/Waste Water Treatment: Literature Review, Research gate, DOI:10.13140/RG.2.1.3112.4006.
- Kushwah, R. K. , Bajpai, A. and Malik, S.(2011) "Waste Water Quality Studies of Influent and Effluent Water at Municipal Waste Water Treatment Plant, Bhopal (India)", International Journal of Chemical, Environmental and Pharmaceutical Research, 2(2-3): 131-134.
- Mahapatra, D.M. and chanakya, H.N.(2013) "Treatment efficacy of algae-based sewage treatment palnts", Environ Monit Assess, DOI 10.1007/s10661-013-3090-x.
- Mihaylova, D., Prokopov, T. and Mihalkov, N.(2014) "Hydrobiological investigation of the activated sludge from sequencing batch reactors of WWTP-Hisarya", Ecologia Balkanica, Vol. 5: 41-47.
- Mithrwal, S., Yadav, R.D. and Angasaria, R.C.(2009) "Water Quality Analysis in Pilani of Jhunjhunu district, Rajasthan-The place of birla's origin", RASAYAN J. Chem., Vol. 2(4): pp 920-923, ISSN: 0974-1496.
- Mustapha, M.U. (2014) "An analysis of physical and chemical parameters in some rivers in Yobe state", IOSR-JESTFT, Vol.-8. Iss(5).ver.III: PP-68-72,e-ISSN:2319-2402, P-ISSN:2319-2399.
- Muthukumaran, N. and Ambujam, N.K.(2003) "Wastewater Treatment and Management in Urban Areas-A Case Study of Tiruchirappalli City, Tamilnadu, India", 284-289.
- Narmada, D., Mary Selvam Kavitha, V.J.(2012) "Treatment of Domestic Waste Water Using Natural Flocculants", IJLBPR, 1(3): 206-213, ISSN 2250-3137.
- Official website of Rajasthan Urban Infrastructure development programme-2008 (www.ruidp.gov.in)(Govt.of Raj F3 (67)/RUIDP/PMU/JNNURM01/inv.bids./2008/ 11572
- Official website of Ajmer Wikipedia (http://en.m.wikipedia.org)
- Official website of Maine center for disease control and prevention, Division of environmental health-2013(www.mainepublichealth.gov/septic-systems)
- Official Website of Urban Improvement trust-2010(www.uitajmer.org)
- Patit, P.S., Sumer, N.R.M. Prasad, D. and Chaudhari, S.(2016) "Design of Sewage Treatment Plant for Dhule City", Int. J. Eng. Res., Vol-5(5): pp: 353-355, ISSN:2319-6890(online), 2347-5013(print).
- Pawari, M.J. and Gavande, S.M.(2015) "Assessment of Water Quality Parameters: A Review," IJSR 4(7): 1427-1431, ISSN (Online): 2319-7064.

- Pipelin.(1997) "National Small Flows Clearing House" 1-800-624-8301, Vol. 8(4).
- Pradhan, A., Bhumik, P., Das, S., Mishra, M., Thakur, S., Chaudhuri, S.R., Mukherjee, I., Khanam, S. and Hoque, B.A.(2008) "Phytoplankton diversity as Indicator of water quality for fish cultivation", Am. J. Environ. Sci., Vol. 4(4): 406-411, ISSN: 1553-345x.
- Samrat, A.D., Wanjule, R.V., Shindem, S. and Pande, B.N.(2012) "Study of the Physico-Chemical Parameters of Harsul Dam, Aurangabad (M.S.)," International Conference SWRDM: 208-213.
- Sanamdikar, S.T. and Harne, K.R.(2012) "Advanced Method for Sewage Water Treatment," International Journal of Advanced Technology in Civil Engineering, ISSN: 2231-5721, 1(2): 94-98.
- Sharma, A., Ranga, M.M. and Sharma, P.C. (2010) "Water Quality Status of Historical Gundolav lake at Kishangadh as a Primary Data for Sustaninable Management", South Asian Journal of Tourism and Heritage, 3(2): 149-158.
- Sharma, K.C., Charan, P.D. and NAG, M.(2008) "An Integrated restoration plan for lake anasagar: A threatened water body of Ajmer, Rajasthan", Department of Environmental Science, MDSU, Ajmer.
- Sharma, S., Yadav, R. Kr., Saini, and Sharma, S. (2011) "Water quality status of Pushkar lake as a primary data for sustainable development", SAJTH, vol-4(2): pp 184-192.
- Shrirang, V. and Chatterjee, K. (2014) "Sewage Treatment and Reuse-A Step towards water conservation," DAMA, International Science Journal, 1(2): 15-22, ISSN: 2348-604x(Print); 2348-6058(Online).
- Singh, S. (2015) "Analysis of Plankton Diversity and Density with Physico-Chemical Parameters of Open Pond in Town Deeg(Bharatpur) Raj. India", Int. Res.J. Biological Science, Vol. 4(11): 61-69, ISSN: 2278-3202.
- Sreelekshmi, S. and Percira, F.G.B. (2017) "Evaluation of physico-chemical parameters and plankton diversity of vellayani lake with speicla reference ot the condition factor of Devario Species", Int. J. Res. Fisheries and Aquaculture, Vol. 7(1) : pp: 31-36, ISSN: 21277-7729.
- Sukhija, L.(2010) "Hydro biological studies of Foy Sagar Lake, Ajmer," An International Quarterly Scientific Journal, Nature Environment and Pollution Technology, 9(3): 601-604.

- Taruni, S. and Kapila, M.(2017) "Phytoplankton population in relation to physico-chemical properties of river tapi, Surat, Gujarat, India", Res. J. Recent Sci., Vol.-6(3), pp:35-37, ISSN 2277-2502.
- Trivedi, R.K. and Goel, P.K. (1986): Chemical and biological method for water pollution studies. Environmental Publications Karad (Maharashtra), India. 248.
- Turkar, S.S., Bharti, D.B. and Gaikwad, G.S.(2011) "Various Method involved in waste water treatment to control water pollution, J. Chem. Pharm. Res., 3(2):58-65, ISSN:0975-7384.
- Vaishnav, S., Sharma, D. and Saraf, A. (2017) "Estimation of water quality physico-chemical and biological parameter of shivnath river in Durg district (Chhattisgarh)", Int. J. Eng. Sci. Res. Tech., Vol-6(3): pp: 288-293, ISSN:2277-9655.
- Verma, S. and Khan, J. B.(2015) "Analysis of water quality by physico-chemical parameters in fateh sagar talab in bagar, district of Jhunjhunu, Rajasthan", IOSR-JPBS, vol-10(5); ver IV, pp 41-45, e-ISSN: 2278-3008, p-ISSN: 2319-7676.
- Wakode, P.N. and Sayyad, S.U.(2014) "performance Evaluation of 25 MLD sewage treatment plant at Kalyan", AJER, Vol.-3(03) : pp-310-316, e-ISSN: 2320-0847, P-ISSN: 2320-0936.

Outline Approved

Signature of Candidate with date

Name and signature of supervisor
With date and seal

Facilities available for the work:

All the necessary research facilities required for the proposed study are available at the Department of Zoology, S.P.C. Govt. College, Ajmer.

Signature
Supervisor / Head Department of Zoology
S.P.C. Govt. College, Ajmer

MAHARSHI DAYANAND SARASWATI UNIVERSITY, AJMER

Appendix-VI

Certificate by Supervisor

Certified that:

1 I am willing to guide the research of **Ms. KHUSHABOO SONI** on the above subject if she registered for Ph.D.

2 To the best of my knowledge, the subject selected has not been studied and is not being studied so far in any University.

3 The subject is of sufficient scope to keep the candidate engaged for two year.

4 The subject will lead to a valuable contribution. I have seen and approved the outline and bibliography, etc. submitted by the candidate.

5 Necessary facilities are available in the department for the above research work, (certificate from principal/head university department with regards to facilities available is enclosed.)

6 I have…….……Research candidate registered under my supervision and the serial number of this candidate whose application being forwarded for registration is……..……..

7 The candidate is not in a close relation (the term of close relation is defined in the examination ordinance of the University).

Signature of the supervisor with date

CERTIFICATE

Certified that the available facilities will be extended to **Ms. KHUSHABOO SONI** for research work if she registered for Ph.D.

Signature of the Principal/
Director of the Institution
with date

Signature of the Supervisor /Head
Department with date